



Economic policies for healthier food intake the impact on different household categories

Nordström, Leif Jonas; Thunström, Linda

Publication date:
2009

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):

Nordström, L. J., & Thunström, L. (2009). *Economic policies for healthier food intake: the impact on different household categories*. Department of Economics, Lund University.
http://swopec.hhs.se/lunewp/abs/lunewp2009_014.htm

Economic Policies for Healthier Food Intake: The Impact on Different Household Categories

Jonas Nordström^a and Linda Thunström^b

^a Institute of Food and Resource Economics, University of Copenhagen,
DK-1958 Frederiksberg C, Denmark

^b The Swedish Retail Institute, SE-103 29 Stockholm, Sweden

Abstract

This paper simulates the impact across household types of fully funded tax reforms designed to increase consumers' fiber intake from grain consumption. Our results suggest that household types with the highest initial consumption share of fiber-rich products – i.e., households without children (seniors, couples without children, and single women without children) – experience the highest increase in fiber intake from these reforms. However, they also experience high increases in unhealthy nutrients from the reforms, making the net health effects difficult to evaluate. Seniors and couples without children also gain the most financially, paying less food taxes and facing, depending on the reform, either a lower price level than before the reform or a lower increase in the price level than the average household. These household types also face the lowest initial price level. Households with the lowest initial consumption share of fiber-rich products – families with children – appear to gain the least financially from the reforms: they pay more food taxes and face relatively high increases in price levels. Further, in general they experience an increase in fiber intake smaller than the average household. However, they do generally see reductions in the intake of added sugar, and in many cases saturated fat, which positively affects the health of families with children, who often overconsume these nutrients.

Key words: consumer economics, food, health, taxation

JEL classification: D12, H23, I18

1. Introduction

The modern diet is often rich in empty calories and fat, and has proven to be a significant risk factor for several types of cancer, cardiovascular disease, diabetes, osteoporosis, and dental caries as well as overweight and obesity, themselves major risk factors of many of these diseases. The World Health Organization states that “improving nutrition could be the single most important contributor to reducing the burden of disease in the WHO European Region” (WHO, 2004, p.27). Poor diet is estimated to cause, for instance, about one third of European cancer deaths and one third of all cardiovascular disease. Cancer and cardiovascular diseases account for almost two thirds of Europe’s total disease burden, measured by losses of years of healthy life (WHO, 2004).

In Sweden, direct and indirect costs solely of obesity and overweight (i.e., disregarding all other illnesses caused by poor nutrition) have been estimated at SEK 3.6 billion (Persson et al. 2004) and SEK 12.4 billion (Persson and Ödegaard, 2005), which is about 3 percent of the total costs (direct and indirect) of all illness (Socialstyrelsen, 2003). These costs may be even higher in the future due to the time lag between the prevalence of obesity and overweight and the serious illnesses that often follow. The externalities imposed on tax payers could justify government intervention aimed at encouraging healthier food consumption.

Increasing the intake of dietary fiber would constitute an important improvement of the nutritional quality of modern diets. A diet high in fiber has several health-promoting effects: helping to maintain a healthy body weight (Burton-Freeman, 2000, Liu et al., 2003), and controlling and preventing heart diseases (Liu et al., 1999, Mann, 2002), diabetes (Brand-Miller et al., 2003, Schulze et al., 2004, Willet et al., 2002), and colorectal cancer (Schatzkin et al., 2007). The Swedish National Food Administration (SLV) therefore recommends that the average Swedish consumer substantially increases his/her fiber intake. The average woman is recommended to increase her intake by a minimum of 56 percent, and the average man by a minimum of 38 percent.¹ Along with fruit and vegetables, grain products are the

¹ The average woman consumes 112 grams of dietary fiber per week, and the average man 126 grams (Becker and Pearson, 2002). Recommended weekly levels are 175–245 grams of dietary fiber for both men and women (SNR, 1997).

most important source of dietary fiber. To increase the fiber intake from grain products specifically, the SLV recommends that the average household should ensure that half of the volume of bread and breakfast cereals it consumes is “Keyhole” labeled. The “Keyhole” is a nutrition symbol certified to products defined as wholesome by the SLV.²

Using grain consumption data, Nordström and Thunström (2009a) simulate the effect of tax reforms aimed at encouraging the average household to increase its fiber consumption by the minimum recommended 38 percent. The authors found that a 50 percent subsidy of wholesome (keyhole labeled) bread and breakfast cereals or a SEK 0.046 subsidy per gram of fiber per kilogram of grain product increased the fiber intake of the average household by 38 percent. However, Nordström and Thunström also show that subsidies in isolation increase not only the intake of fiber but also the intake of nutrients that are often overconsumed (fat, saturated fat, sugar, added sugar, salt). The authors therefore simulated reforms that are fully funded by taxing these nutrients or goods that are considered as unhealthy, and conclude that the revenue-neutral tax scheme that appears to be most efficient in redirecting consumption to healthier levels is a subsidy on fiber, funded either by an excise duty on added sugar or an excise duty on saturated fat. Building on the results in Nordström and Thunström (2009a), we analyze the effect across household types of reforms designed to increase the fiber intake from grain consumption.

Our focal points when analyzing the impact of these policy reforms across household categories is the impact on the intake of fiber and other nutrients, the volumes consumed, changes in tax payments by different household types, and the change in the price level faced by the household types. To perform the analysis, we estimate a demand system for grain products and thereafter simulate the results of the above tax reforms.

Empirical literature on the effects of economic policies aimed at improving the nutritional content of food consumed is limited, especially for studies analyzing the effects across

² Breakfast cereals that meet the following criteria can be certified with the Keyhole logo issued by the SLV: fat max. 7g/100g, sugar max. 13g/100g, sodium max. 500mg/100g, fiber min. 1.9g/100 kcal. For soft bread the criteria are as follows: fat max. 7g/100g, sugar max. 10g/100g, sodium max. 600mg/100g, fiber min. 1.9g/100 kcal. For crisp bread, the certification criteria are: fat max. 8g/100g, sodium max. 600mg/100g, and fiber min. 1.9g/100 kcal.

different household types. Smed et al. (2007) analyze the impact of tax reforms on the intake of fiber, saturated fat, and sugar across age and income groups. They find that young households have a higher elasticity of demand for saturated fat, whereas middle-aged households have a higher elasticity of demand for sugar. In general, the lowest income group is found to be the most responsive to food price changes. Chouinard et al. (2007) analyze the effect of a 10 percent ad valorem tax on the percentage of fat in dairy consumption. They conclude that the tax has little effect on fat consumption and would also lead to particularly large welfare losses for elderly and poorer households.

To the best of our knowledge, this is the first study to analyze the distributional effects of policy instruments designed to direct consumption towards specific nutritional recommendations. It is also the first study to examine the distributional effects of revenue-neutral tax schemes incorporating combinations of excise duties on nutrients. This paper therefore provides a valuable insight into the effects of different designs of tax schemes that could be used to improve the quality of the modern diet, and with important information that is not available in an analysis for the average household.

In sections 2 and 3, we present the data and the modeling framework; section 4 contains the results of the analysis and section 5 concludes the study.

2. Data

To estimate the demand system for grain products, we use private market research data from “Growth from Knowledge” (GfK) Sweden and household expenditure data (HUT) on bread purchases from Statistics Sweden. The GfK data are based on diary recordings of grain product purchases for 2003. Our sample consists of the 1336 households who participated in the panel for the whole year. The data contain information on daily retail purchases of bakery goods, bread, breakfast cereals, frozen and fresh ready-to-eat food, pasta, rice, and flours. The product information includes the type, price, and size of the products bought. An exception is soft bread, for which the GfK households are only requested to state the total expenditures on soft bread. To obtain information on the type of bread purchased, we use the 1996 household expenditure data (HUT) from Statistics Sweden, which includes information on the amounts of types of soft bread (white or dark) purchased, as well as an index for bread prices.

Further, the GfK data contain information on the number of children, the number of adults, sex and the age of the head of the household. Based on this information, we control for nine different household categories in the estimation and simulations of the tax reforms: single woman without children, single woman with children, single man with or without children, couple without children, couple with one child, couple with two children, couple with three or more children, three or more cohabiting adults (minimum 17 years of age) and senior households, of any number of adults and children.

The HUT data comprise 1104 households, and contains the same demographic information as the GfK data set, as well as two additional categories: unknown household type with children, and unknown household type without children. In addition to the household categories defined above for the GfK data these are also controlled for in the estimation.

The products purchased by the GfK and HUT households are matched with their nutritional value provided by the nutrient database maintained by the SLV. For convenience, we refer to fat, saturated fat, sugar, added sugar, and salt as the “unhealthy” nutrients, due to the fact that the average household is likely to overconsume these nutrients. For a household with low food consumption, an increased intake of these nutrients might, however, be health enhancing. Descriptive statistics of the product contents are given in Table 2.1.

Insert Table 2.1 here.

Table 2.2 shows the proportion of Keyhole-labeled bread and breakfast cereals consumed relative to total bread and breakfast cereal consumption by household type, as well as the proportions of bakery goods and ready meals consumed relative to total household consumption of grain products.

Insert Table 2.2. here.

For the average household, the proportion of Keyhole-labeled bread and breakfast cereals purchased, of total bread and breakfast cereal purchases, is 47 percent. Households without

children (single women, couples, and seniors) all achieve the nutritional recommendation that half of the bread and breakfast cereals they consume should be Keyhole labeled. Families with children far from reach this recommendation, however, and the more children per adult head, the lower the share of Keyhole-labeled bread and breakfast cereals purchased. The relatively poor nutrition of families with children is reflected by studies suggesting that children overconsume fat and sugar (see e.g., Rasmussen et al., 2004) as well as that adults in families with children generally seem to have a higher intake of added sugar and a lower intake of fiber than adults in households with no children. This pattern seems to be more pronounced for adult women than for adult men (Enghardt Barbieri and Lindvall, 2003).³

3. The Modeling Framework

In the modeling of grain consumption we assume that the decision process take part in multiple steps, according to Figure 1. At the highest level, the household allocates its (total) resources for grain expenditures between three broad product categories: prepared foods, ready meals, and staple goods for cooking. When the household has determined the expenditures for each category, it decides how to allocate these expenditures between the product groups within each category.

Insert Figure 1 here.

We are unable to observe total household consumption of grain products since some are consumed outside the home (e.g., in restaurants and at school). The relative consumption of different grain products is, however, likely to be well reflected in the data set. We use the quadratic extension (Banks et al. 1997) to Deaton and Muellbauer's (1980) almost ideal demand system – the QAIDS – as our model specification. The QAIDS provides a flexible functional form of consumer preferences, based on relative consumption (budget shares). Another appealing feature of the QAIDS is that it handles non-linear expenditure (or income)

³ For descriptive statistics on the average budget shares for each household category, see Nordström, J. and Thunström, L. (2009) The Impact on Different Household Types of Economic Policies Designed to Increase the Fiber Intake from Grain Consumption, *HUI Working Paper No 22*

effects, which may be particularly important when simulating the impact of reforms that lead to large price effects. We take into account the differences in consumption patterns between household categories by adding intercept and slope parameters in the budget share equations of the demand system. As we cannot observe the households' consumption of other goods, we have to assume that household preferences are weakly separable in grain consumption and other goods. To reduce the number of estimated parameters, we also assume that household preferences are weakly separable into ready meals, staple goods for cooking, and prepared foods. The full decision process and the separability assumptions that follow from this process are shown in Figure 1.

An econometric consideration arises as not all of the households in the sample purchased all of the goods in 2003. For example, for fresh filled and fresh unfilled pasta, the occurrence of zero expenditure is as high as 92 and 83 percent. To allow for infrequencies of purchases, Blundell and Meghir (1987) presented a bivariate alternative to the Tobit model (Tobin, 1958, and Amemiya, 1974) with separate processes determining the censoring rule and the continuous observations. It seems reasonable to assume that there are separate processes determining the zero-one decision of buying a good and the decision of how many units to actually buy. Therefore, to obtain consistent parameter estimates, we follow Heckman's (1979) two-step procedure and estimate separate probit and truncated regression models for each food group.

At the first allocation step household h decides how much of grain products to consume (i.e., the resource allocation over staple goods for cooking, prepared foods, and ready meals). Based on the simplification of the original model by Blundell et al. (1993), household h 's budget share for good k , s_k^h , in the first allocation stage then takes the form

$$s_k^h = \alpha_k(\mathbf{d}^h) + \sum_l \gamma_{kl} \ln p_l^h + \beta_k(\mathbf{d}^h) \times \ln[x^h / P^h] + \delta_k(\mathbf{d}^h) \times (\ln[x^h / P^h])^2 + \varphi_k \hat{\lambda}_k^h + \varepsilon_k^h \quad \begin{matrix} k = 1, \dots, n \\ h = 1, \dots, r \end{matrix} \quad (1)$$

where p_l^h is the price of good l , x^h is household h 's total expenditure on the $k = 1, \dots, n$ grain product groups, $\ln P^h = \sum_k s_k^h \ln p_k$ is the household specific Stone's price index and \mathbf{d} is a

vector of household characteristics, containing the household categories defined in the data section. The reference household consists of a full-time working single woman without children. ε_k^h is an error term reflecting unobserved taste variation and r denotes the subsample for which $s_k^h > 0$. $\hat{\lambda}_k^h = \phi(\hat{\psi}_k \mathbf{z}_k^h) / \Phi(\hat{\psi}_k \mathbf{z}_k^h)$ is the estimated inverse Mills ratio, with $\hat{\psi}_k$ estimated in a first step from a univariate probit model for group k (see e.g., Leung and Yu, 1996). The explanatory variables included in \mathbf{z}_k are the prices of the products in equation k , the household income, and the same set of dummy variables as those contained in the \mathbf{d} vector. Although the notation in equation (1) refers to the demand for the k goods in the first allocation stage, the same procedure is used in the estimation of all subdemand systems, see Figure 1. For instance, the demand system for the second stage of expenditure allocation has the same functional form as (1), and can be written as

$$s_{(k)i}^h = \alpha_{(k)i}(\mathbf{d}^h) + \sum_l \gamma_{(k)ij} \ln p_{(k)j}^h + \beta_{(k)i}(\mathbf{d}^h) \times \ln[x_k^h / P_k^h] \\ + \delta_{(k)i}(\mathbf{d}^h) \times \left(\ln[x_k^h / P_k^h] \right)^2 + \varphi_i \hat{\lambda}_i^h + \varepsilon_i^h \quad i = 1, \dots, m \quad (2)$$

where $s_{(k)i}^h$ is household h 's budget share for good i within group k , $p_{(k)j}$ is the price of good j in group k , and x_k^h are the total expenditures that household h has allocated to the goods in group k in the first-stage allocation problem.

The expenditure system has a set of within-equation and cross-equation restrictions that we impose. Homogeneity is imposed in a first stage by estimating single equations. Since the number of observations will differ for different goods after the selection of $s_k^h > 0$, we use a minimum distance estimator (see Ferguson, 1958) to impose the cross-equation (symmetry) restrictions in a second stage. We employ White's (1980) approach to calculate the standard errors.

3.1 Simulations

Building on the results in Nordström and Thunström (2009a), we will simulate the following four revenue-neutral policy reforms:

- i *A revenue-neutral VAT reform* entailing zero VAT on Keyhole-labeled bread and breakfast cereals funded by VAT on bakery goods and ready meals of 34.2 percent, while maintaining the VAT on all other grain products at the initial 10.71 percent.⁴
- ii *A revenue-neutral VAT reform* entailing a 50 percent subsidy of the consumer price of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals, while keeping the VAT on all other grain products at the initial 10.71 percent.
- iii *A revenue-neutral excise duty reform* entailing a SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by an excise duty of SEK 0.182 per gram of added sugar.
- iv *A revenue-neutral excise duty reform* entailing a SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by an excise duty of SEK 0.325 per gram of saturated fat.

In the simulations we start by calculating the percentage price change due to a specific tax reform, and translate these changes to post-reform prices and Stone price indices. The VAT on food in Sweden is 10.71 percent of the consumer price (or, equivalently, 12 percent of the producer price), which constitutes the baseline for the analysis. The estimated parameters from the demand system and the post-reform Stone price index, as well as the estimated error terms, for the first allocation stage are thereafter substituted into the expenditure equations for the first allocation stage (as specified by equation (1)), and new budget shares are calculated. Assuming separability between grain consumption and other consumption, the post-reform total nominal expenditures are the same as the ex ante reform nominal expenditures on grain consumption. We therefore multiply the post-reform budget shares from the first allocation

⁴ Subsidies are not applied to Keyhole-labeled flours that could be used for bread making, since they could also be used for other, less healthy, purposes.

stage by the pre-reform nominal expenditures for total grain consumption, which gives us the post-reform nominal expenditures for prepared food, staple goods for cooking, and ready meals. These expenditures and the new Stone price indices are, in turn, substituted into the estimated equations representing the second allocation stage, and new budget shares are calculated. In the case of additional subgroups, the procedure is repeated for the subsequent allocation stages.

In addition to calculating new budget shares, we also calculate the change in the consumption volume for each product. The change in the intake of different nutrients (e.g., fiber, added fat, or added sugar) due to the reform, is obtained by multiplying the change in consumption volume of a certain product by the content per kilogram of a specific nutrient in that particular product (see Table 2.2). In the simulations we also calculate the percentage change in tax payments for the household. For a more comprehensive description of the simulation procedure, see Nordström and Thunström (2009a).

4. Estimation and simulation results

F-tests indicate that the estimates of the parameters of the β and δ functions, in the original specification, are not significantly different from zero. We have therefore reduced the number of estimated parameters in the final specification of the model and excluded the household-specific parameters from these functions. Likelihood ratio tests suggest that the homogeneity restriction generally cannot be rejected. Chi-square tests indicate that the symmetry restrictions are rejected for only two (pasta and bread) of the nine estimated demand systems, at a 5 percent significance level. The adjusted *R*-square is generally high and ranges from 0.2 to 0.6. Overall, the model fit is found to be good.

All own price elasticities are negative and in line with elasticities reported by previous studies (e.g., Chouinard et al., 2007, and Kuchler et al., 2005). The uncompensated own price elasticities range from -0.21 for wholegrain pasta to -1.56 for “other” breakfast cereals. There seems to be little difference in the price sensitivity for Keyhole-labeled bread or breakfast cereals compared to non-Keyhole products. The price sensitivity for the more unhealthy bakery products seems to be relatively low (around 0.60 for all subgroups) but the price

sensitivity for ready meals seems to be well in line with the price sensitivity for other groups. The rich set of cross-price elasticities is not reported in the table but is, as expected, much smaller in absolute value than the own price elasticities. Expenditure elasticities are also of the expected sign, ranging from 0.13 and 0.15 for filled pasta and white wheat crisp bread to 1.16 and 1.45 for muesli and white wheat flour.

In subsection 4.1 below, we report the impact of the different reforms on consumption and nutritional intake. Subsection 4.2 contains an analysis of the tax effects on the price level for different household types.

4.1 The impact on consumption and tax payments of the simulated reforms

(i) A removal of VAT on Keyhole-labeled bread and breakfast cereals funded by 34.2 percent VAT on bakery goods and ready meals

Removing the VAT on Keyhole-labeled products, and fully funding the reform by a tax on bakery goods and ready meals of 34.2 percent, results in only marginal increases in fiber intake, varying between 2 and 3 percent across the household categories (see Appendix). In addition, the effect of this reform on the price level facing different household types (as determined by their consumption basket) is minor. We therefore expect that removing the VAT on Keyhole-labeled products, while taxing bakery goods and ready meals, would have little if any effect on public health. We will focus our comments on the results of the more extensive tax reforms.

Insert Tables 4.2a and 4.2b here.

(ii) A 50 percent subsidy of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals

Tables 4.2a and b show the results of the more extensive revenue-neutral VAT reform, where Keyhole-labeled bread and breakfast cereals are subsidized by 50 percent, and bakery goods and ready meals are taxed with 113.8 percent VAT. The simulation suggests that this reform

results in all households, except couples with three or more children, attaining the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. Three household types experience an increase in fiber intake greater than the average household (35 percent) as a result of this reform – seniors, single women without children, and couples without children – and seniors even achieve the minimum recommended 38 percent increase. The smallest increase in fiber intake is noted for households consisting of a single woman with children. The generally large increase in fiber intake is a result of all household types substantially increasing their proportions of Keyhole-labeled bread and breakfast cereals consumed. The increase in the fiber intake is, however, accompanied by increases in the intake of kilojoules and unhealthy nutrients (fat, saturated fat, salt, sugar and added sugar), even if the consumption share of bakery goods and ready meals shrinks for all household types. The latter is true for all household types except households consisting of two adults and three or more children and households of three or more adults.

Even though all households experience sizeable increases in the intake of unhealthy nutrients, those that experience the highest increase in the intake of fiber also experience the highest increase in the intake in the unhealthy nutrients, and vice versa. This result implies that healthier, i.e., Keyhole-labeled, products contain both healthy and unhealthy ingredients, and that post-reform households choose a grain product basket that is not only higher in fiber but also higher in other nutrients. For instance, for seniors, the increase in the intake of salt and sugar is as high as 29 and 25 percent, respectively. Although increases are smaller for other household types, the pattern is similar. The net health effects on different household types of this reform are therefore uncertain.⁵

Further, our results suggest that the household types that gain financially from the reform are couples without children and seniors, measured by a decrease in VAT payments. They seem to adjust their consumption such that their VAT payments from grain products decrease by 16 and 61 percent, respectively. All families with children, as well as single women without children and single men, experience substantial increases in VAT payments as a result of this reform.

⁵ Since the initial nutritional quality of the diet of families with children is relatively poor compared to families without children, even relatively small increases of unhealthy nutrients might be important, though.

(iii) A SEK 0.046 subsidy per gram of fiber per kilogram of grain product funded by an excise duty of SEK 0.182 per gram of added sugar

Changes that may more efficiently control the intake of unhealthy nutrients could be excise duty reforms that directly target the nutrients, i.e., a subsidy of the fiber content funded by a tax on some, or some combination of, unhealthy nutrient(s). Here, we simulate the results across household types of the SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by either an excise duty on added sugar, amounting to SEK 0.182 per gram of added sugar in grain products, or an excise duty on saturated fat, amounting to 0.325 per gram of saturated fat. Tables 4.3a-4.3b show the simulated results across household types of the SEK 0.046 fiber subsidy funded by a SEK 0.182 excise duty per gram of added sugar.⁶

Insert Tables 4.3a-4.3b here.

With the SEK 0.046 subsidy per gram of fiber per kilogram of product, funded by a SEK 0.182 excise duty on each gram of added sugar, we find that single men and households consisting of three or more adults attain the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. However, for the other household types that did not attain this recommendation before the reform, and who initially had the lowest consumption share of Keyhole-labeled bread and breakfast cereals (households with children, i.e., single women with children, and couples with one, two, three, or more children), the reform does not achieve the recommendation of half of bread and breakfast cereal consumption being Keyhole labeled. Further, across all household types, our results suggest that the increase in fiber intake is lower than that achieved by the extensive VAT reform. However, the increase in unhealthy nutrients is also lower, with all household types even experiencing a decrease in the intake of added sugar. Those household categories with the

⁶ Note that the SEK 0.046 fiber subsidy results in the same increase in fiber intake for the average household (the minimum recommended 38 percent) as the 50 percent subsidy of Keyhole-labeled bread and breakfast cereals.

Nordström and Thunström (2009a) show that the fiber subsidy is more cost efficient than the subsidy of Keyhole-labeled products. Here, both reforms are revenue neutral, however, since the subsidy of Keyhole-labeled bread and breakfast cereals is funded by taxes on bakery goods and ready meals, and the fiber subsidy is funded by an excise duty on either added sugar or saturated fat.

highest consumption share of Keyhole-labeled products already, namely couples without children and seniors, show an increase in fiber intake from this reform higher than the average household (15 percent): our results suggest that the increase in fiber intake for couples without children would be 17 percent, and for seniors even higher, 20 percent. Again, however, those households with the largest increases in fiber intake also experience larger than average increases in their consumption of fat, saturated fat, kilojoules, and salt. In contrast, fiber intake increases only marginally for households with many children per adult. For households consisting of a single woman with one or more children, the fiber intake increases by 2 percent, whereas for households consisting of two adults with three or more children the fiber intake increases by only 1 percent. At the same time, the decrease in the intake of added sugar is particularly marked for these households: 22 percent for single women with children and 32 percent for two adults with three or more children.

Similar to the VAT reform, couples without children and seniors are best off financially from the reform, since implementing the reform means a decrease in VAT and excise duty payments of 14 and 32 percent, respectively, for these household types. Generally, the increase in food tax payments by the other household types was still pronounced, though smaller than the increase from the VAT reform, the exception being households consisting of a couple with three or more children or households of three or more adults, who experience greater increases in food tax payments.

(iv) A SEK 0.046 subsidy per gram of fiber per kilogram of grain product funded by an excise duty of SEK 0.325 per gram of saturated fat.

Tables 4.4a-4.4b show the results across household types of the SEK 0.046 subsidy per gram of fiber funded by an excise duty of SEK 0.325 per gram of saturated fat.

Insert Tables 4.4a-4.4b here.

Simulating the impact of an SEK 0.046 subsidy per gram of fiber per kilogram of product, funded by an excise duty of SEK 0.325 per gram of saturated fat, we again find that the reform does not result in those households with the lowest initial consumption shares of Keyhole-labeled bread and breakfast cereals (households with children – single women with children, couples with one, two, three, or more children) achieving the recommendation of

half of bread and breakfast cereal consumption being Keyhole labeled. And, again, for all household types the fiber intake increased by less than the increase under the VAT reform. Further, for most household types, the fiber intake increased by less than under the corresponding excise duty reform with an excise duty on added sugar, single women with children and couples with three or more children being the exception. However, for these household categories, the increase in fiber intake from this reform is still small (3 and 4 percent, respectively) and, again, the only household types experiencing an above average increase in fiber intake are couples without children and seniors (increases of 13 and 15 percent, respectively). All household types except seniors see a reduction in intake of both saturated fat and added sugar as a result of this reform, and most household types, with the exception of couples without children and seniors, see a reduction in fat intake. For seniors, the reform results in increases in all unhealthy ingredients, though the increases in saturated fat, added sugar, and sugar are marginal (1-2 percent). For single women without children and couples without children, too, we find increases in the majority of unhealthy ingredients. For the other household types, the general finding is that the intake of unhealthy ingredients decreases as a result of the reform.

As with the VAT reform simulations and the excise duty reform with excise duty on added sugar, seniors and couples without children are financially better off after the above reform compared to baseline. VAT and excise duty payments by these households would decrease by 27 and 14 percent, respectively, if the reform were implemented. Other household types would be financially worse off compared to baseline. Compared to the VAT reform, however, all households would be financially better off after this reform except for couples with three or more children, couples without children, and seniors. Compared to the excise duty reform with duty on added sugar, the reform with duty on saturated fat results in much higher increases in food tax for single women without children and single men, whereas single women with children, and couples with two, three, or more children would experience a much lower increase in food tax payments.

4.2 Effects on price levels for different household types

Insert Table 4.5 here.

Table 4.5 shows both the initial price levels faced by different household types and the relative change in price level (as measured by the antilog of Stone's price index) as a result of household reallocations of consumption after the policy reforms. As shown by column 1 in Table 4.5, seniors and couples without children face the lowest initial price levels, whereas single women without children and single men with or without children face the highest price levels.

Our results suggest that couples without children, couples with three or more children, and seniors would all face lower price levels than at baseline if the more extensive VAT reform (50 percent subsidy of Keyhole-labeled products, 113.8 percent VAT on bakery goods and ready meals) were implemented. The opposite is the case for all other household types. Best off are the seniors, who face a post-reform price level of 94 percent of the pre-reform level. The household types facing the highest increase in price level are single men with or without children and couples with two children; both groups face an increase in price level of 3 percent compared to baseline.

All household categories would see an increase in the price level they face for grain products if the SEK 0.046 fiber subsidy funded by a SEK 0.182 excise duty on added sugar were implemented, as shown by column 3 in Table 4.5. Further, all household types experience a higher increase in price level relative to the simulated price level increase from the VAT reform. The highest price increases are found for families with children, rising as much as 20 percent for families of two adults and three or more children. For seniors and couples without children, the excise duty reform entailing a fiber subsidy funded by a tax on added sugar results in a smaller increase in price level than for the average household. For all other household types, the price level increases by more than for the average household.

If we introduce the same fiber subsidy, funded instead by SEK 0.325 excise duty on saturated fat, the increase in the overall price level for different groups is less pronounced. Compared to the VAT reform, increases in the price level faced by all households are higher from this reform. Compared to an excise duty on added sugar, however, increases are lower, except for single men with or without children. Compared to baseline, the highest price increases are, nevertheless, again experienced by families with children. And compared to the other household types, the price increase for single men, with or without children, is relatively sizeable too, 5 percent.

5. Conclusions

We estimated a demand system on grain consumption and thereafter simulated the effect across household types of four fully funded policy reforms designed to improve the quality of the grain diet. The policy objectives used in the paper are derived from nutritional recommendations for grain products of the Swedish National Food Administration (SLV). These recommendations are that the average consumer should double his/her consumption of bread and breakfast cereals, ensuring that half of the consumption is Keyhole labeled, as part of an overall objective of increasing the fiber intake by a minimum of 38 percent.

The reforms simulated are: (a) a relatively small VAT reform of zero VAT on Keyhole-labeled bread and breakfast cereals and 34.2 percent VAT on bakery goods and ready meals, while keeping the VAT on all other grain products at the initial 10.71 percent; (b) a more extensive VAT reform entailing a 50 percent subsidy of Keyhole-labeled products funded by 113.8 percent VAT on bakery goods and ready meals; (c) an excise duty reform entailing a SEK 0.046 subsidy per gram of fiber per kilogram of grain product, funded by SEK 0.182 excise duty per gram of added sugar per kilogram of product; and (d) an excise duty reform entailing a SEK 0.046 subsidy per gram of fiber per kilogram of product funded by SEK 0.325 excise duty per gram of saturated fat per kilogram of grain product.

The general findings for all the simulated reforms are that those households that see the greatest improvement in fiber intake and consumption of Keyhole-labeled bread and breakfast cereals – i.e., *households without children* (seniors, couples without children, and single women without children) – are those that already consume the highest proportion of Keyhole-labeled products. In addition, our results suggest that seniors and couples without children are the household types that gain the most financially from all reforms simulated here compared to baseline. They would pay less food taxes if the reforms were implemented, and if the VAT reform were implemented, they would face a lower price level than before the reform, while for the excise duty reforms, they would see a lower increase in the price level than that experienced by the average household. These household types also face the lowest initial price level for grain products.

Households that initially consumed the lowest proportions of fiber-rich products (and generally consume less of nutritious food) – namely, *families with children* (single parents with one or more children and couples with one, two, or three and more children) – generally seem to gain the least financially from the reforms simulated here. Compared to baseline, they pay more food taxes if the reforms are implemented, and the reforms also result in relatively high increases in the price level they face, with this increase in price level generally higher than that experienced by the average household. Further, they generally experience an increase in fiber intake that is smaller than for the average household. However, all the reforms simulated here result in a reduced intake of added sugar for families with children (and in many cases also reductions in the intake of saturated fat), positively affecting the nutritional quality of their food consumption. Families with children generally overconsume both added sugar and saturated fat.

However, any sizeable increase in the intake of fiber as a result of the reforms simulated here is generally accompanied by an increase in kilojoules and unhealthy nutrients (fat, saturated fat, salt, and sugar), even though the subsidies of fiber-rich products or the fiber content are funded by taxes on unhealthy nutrients. The higher the increase in the intake of fiber, the higher the increase in the intake of unhealthy nutrients. This means for example that seniors who experience high increases in the intake of fiber from all reforms also experience high increases in their intake of unhealthy nutrients. This might be due to fiber-rich products not only containing fiber, but also other ingredients (see Table 2.1), the intake of which will increase if the consumption of fiber-rich products increases. This result generally makes it difficult to evaluate the net health effect of implementing policy reforms designed to increase fiber intake. However, controlling the intake of unhealthy nutrients appears easier with excise duty reforms than with VAT reforms, and for some household types the intake of unhealthy nutrients even decreases. Unfortunately, excise duty reforms are harder to implement than VAT reforms.

In contrast to Chouinard et al. (2007), we find no evidence of elderly being worse off financially compared to other groups from reforms designed to increase the nutritional content of the food intake. Our findings suggest that the elderly (seniors) and couples without children are well off, should tax reforms designed to encourage healthier grain consumption be implemented. These households gain the most, both nutritionally from increased fiber intake and financially from paying less food taxes – depending on the reform, facing either a lower

price level than before the reform or a lower increase in the price level than that faced by the average household. Those who seem to gain least from the reforms simulated here are families with children, who generally see a smaller than average increase in fiber intake, pay more food taxes, and face relatively high increases in price levels.

The study has limitations in that it focuses only on grain consumption and assumes weak separability between grain and other consumption. Preferably, the demand system would be extended to include all household consumption. For instance, the difference between our results and those of Chouinard et al. (2007) could be due to analyses of different food groups. Also, financial measures are insufficient here in measuring welfare. The study assumes implicitly that health increases welfare and that increasing the fiber intake positively affects health, while increasing the intake of unhealthy nutrients negatively affects health. Ideally, we would know the net health effects of increases/decreases in the intake of different nutrients, and thereby be able to calculate welfare effects of the simulated reforms. Finally, it is important to consider distributional effects across other household dimensions, such as income groups. We leave these and other issues to future research.

Figure 1. Household demand

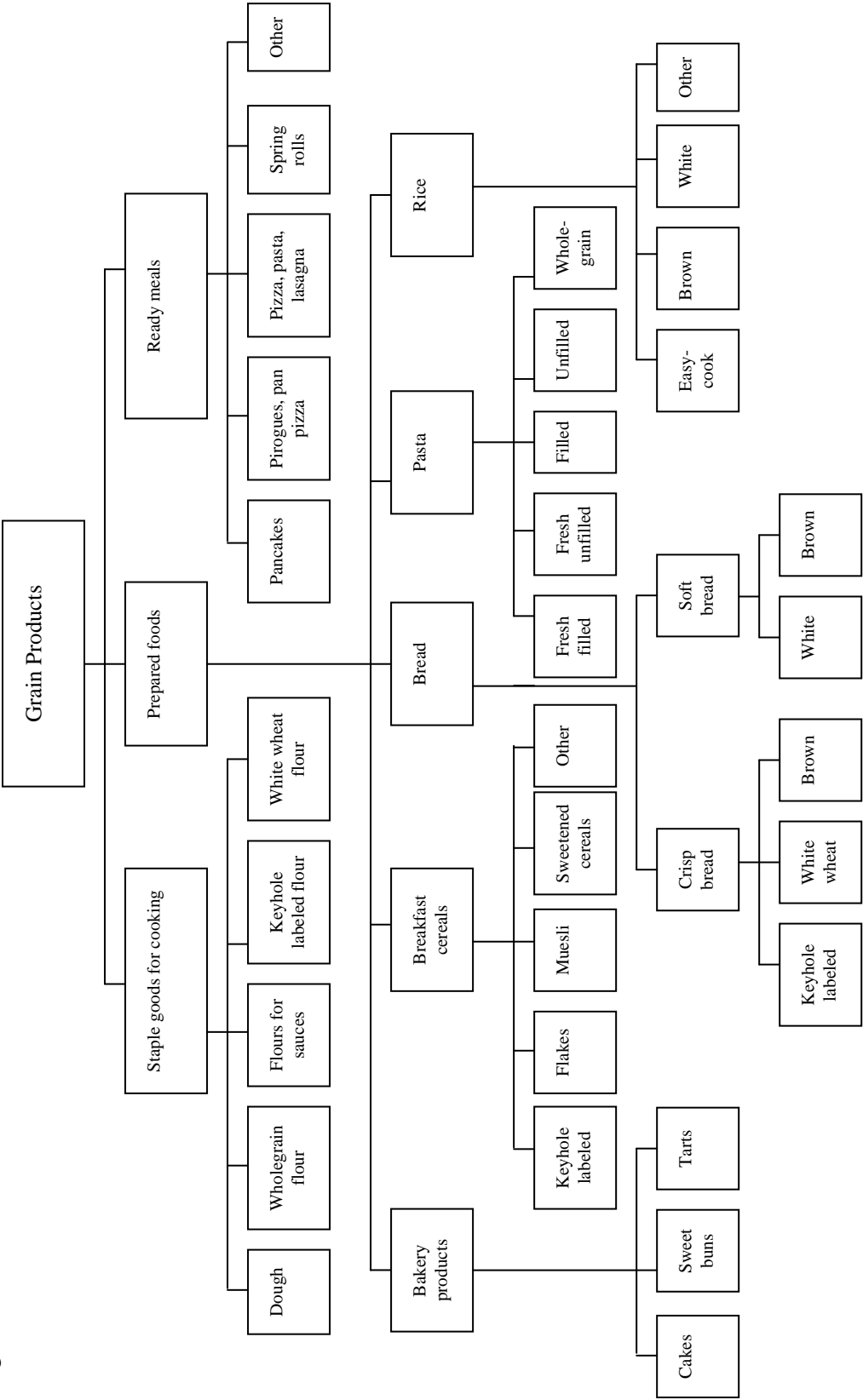


Table 2.1. Average contents of product groups, per 100 grams

	KJ	Total fat	Saturated fat	Sugar	Added sugar	Salt	Fiber
Bakery goods							
Cakes	1631.71	24.29	6.33	27.89	25.35	164.26	2.25
Sweet buns	1633.77	20.12	8.23	11.64	6.32	267.47	2.12
Tarts	1084.16	13.62	6.21	17.23	13.45	133.76	1.60
Breakfast cereals							
Flakes	1568.93	1.95	0.35	13.46	10.12	895.30	4.23
Keyhole-labeled	1448.28	3.67	0.51	2.65	1.73	199.00	9.88
Muesli	1578.77	9.26	3.41	23.37	15.14	256.96	10.80
Sweetened cereals	1614.75	1.26	0.25	38.39	28.86	467.08	2.56
Others	1567.01	4.30	1.24	21.44	16.60	368.64	6.21
Flours and dough							
Wholegrain flour	1417.67	2.33	0.28	2.74	0.43	2.64	4.62
Flour for sauces	1407.06	0.69	0.09	1.13	0.51	4.48	3.03
Keyhole-labeled flour	1344.52	3.33	0.48	1.24	0.65	3.41	10.89
White wheat flour	1504.68	1.88	0.26	1.53	0.26	0.80	3.60
Dough	2340.20	39.51	17.08	1.10	0.12	309.44	1.60
Crisp bread							
Keyhole-labeled	1359.82	2.61	0.38	1.73	0.43	470.20	14.29
White wheat	1636.54	7.41	1.79	4.52	0.42	417.19	5.38
Brown	1425.18	3.98	0.99	3.56	0.29	540.53	11.78
Pasta							
Fresh filled	708.24	9.15	4.07	0.98	0.14	522.37	0.83
Fresh unfilled	877.06	1.61	0.42	1.01	0.10	297.63	1.78
Filled	767.16	9.90	4.38	1.03	0.18	569.30	1.03
Unfilled	528.50	0.50	0.05	0.20	0.10	1.00	1.12
Wholegrain	473.30	0.52	0.06	0.17	0.10	0.10	3.04
Ready meals							
Pancakes	807.95	8.81	3.73	4.37	0.01	331.15	0.77
Pirogues, pan pizza	1541.16	23.43	10.11	1.82	0.31	533.81	1.36
Pizza, pasta, lasagne	910.06	9.73	4.14	2.20	0.20	472.06	1.43
Spring rolls	896.20	10.80	2.94	2.80	0.20	510.00	1.20
Others	1024.73	13.26	5.88	2.07	0.25	462.82	1.36
Rice							
Easy-cook	490.91	0.30	0.07	0.32	0.28	270.07	0.50
Brown	443.54	0.70	0.18	0.49	0.32	2.62	1.12
White	515.25	0.34	0.10	0.15	0.15	307.07	0.48
Others	520.56	0.29	0.10	0.09	0.11	171.77	0.36
Soft bread							
Brown	1025.82	3.07	0.55	6.03	0.31	358.77	6.47
White	1160.12	4.11	0.81	4.07	0.21	404.35	3.62

Table 2.2. Household shares of healthy and unhealthy products

Household type	Share of Keyhole-labeled bread and breakfast cereals		Share of bakery goods and ready meals	
Average household	0.47		0.03	
Single woman	0.52		0.05	
Single woman with children	0.33		0.03	
Single man with/without children	0.47		0.07	
Couple	0.52		0.02	
Couple with 1 child	0.39		0.03	
Couple with 2 children	0.39		0.03	
Couple with ≥ 3 children	0.32		0.02	
Three adults	0.45		0.03	
Seniors	0.52		0.03	

Table 4.2a. Results of policy reform (ii), a 50 percent subsidy of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals

	Average household	HOUSEHOLD CATEGORY			
		Single women	Single women with ch.	Single men ^a	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.69	0.71	0.56	0.69	0.72
Share of bakery goods and ready meals, BR ^b	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR ^b	0.02	0.04	0.02	0.05	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.38	0.41	0.22	0.35	0.42
Volumes of bakery goods and ready meals	-0.10	-0.16	-0.02	-0.28	-0.06
Fiber	0.35	0.35	0.21	0.31	0.36
Fat	0.12	0.10	0.02	0.04	0.15
Saturated fat	0.05	0.02	-0.04	-0.03	0.09
Kilojoules	0.17	0.16	0.07	0.12	0.18
Salt	0.21	0.19	0.08	0.15	0.24
Sugar	0.21	0.19	0.09	0.20	0.23
Added sugar	0.07	0.05	-0.01	0.08	0.10
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.00	0.91	1.08	1.78	-0.37

Note: ^a with and without children. ch. = children, ^b BR = before reform, AR = after reform.

Table 4.2b. Results of policy reform (ii), a 50 percent subsidy of Keyhole-labeled bread and breakfast cereals funded by 113.8 percent VAT on bakery goods and ready meals

	HOUSEHOLD CATEGORY				
	Couple, 1 child	Couple, 2 children	Couple, ≥ 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.39	0.39	0.32	0.41	0.55
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.61	0.62	0.46	0.63	0.75
Share of bakery goods and ready meals, BR ^b	0.03	0.03	0.02	0.02	0.03
Share of bakery goods and ready meals, AR ^b	0.02	0.02	0.01	0.02	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.30	0.32	0.33	0.35	0.45
Volumes of bakery goods and ready meals	-0.11	-0.11	0.09	0.10	-0.11
Fiber	0.26	0.25	0.23	0.30	0.38
Fat	0.04	0.02	0.04	0.09	0.16
Saturated fat	-0.02	-0.04	-0.02	0.02	0.10
Kilojoules	0.10	0.09	0.10	0.14	0.20
Salt	0.13	0.11	0.10	0.15	0.29
Sugar	0.11	0.14	0.06	0.15	0.25
Added sugar	-0.01	0.00	-0.04	0.03	0.10
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.78	1.06	0.20	0.02	-0.61

Note: ^b BR = before reform, AR = after reform.

Table 4.3a. Results of policy reform (iii), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of added sugar of SEK 0.182

	Average household	HOUSEHOLD CATEGORY			
		Single women	Single women with ch.	Single men ^a	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.54	0.59	0.40	0.53	0.58
Share of bakery goods and ready meals, BR ^b	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR ^b	0.03	0.05	0.03	0.07	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.03	0.05	-0.05	0.02	0.05
Volumes of bakery goods and ready meals	-0.10	-0.07	-0.13	-0.03	-0.09
Fiber	0.15	0.14	0.02	0.08	0.17
Fat	0.05	0.05	-0.03	0.00	0.08
Saturated fat	0.00	0.00	-0.07	-0.03	0.02
Kilojoules	0.10	0.09	0.00	0.04	0.12
Salt	0.01	0.01	-0.05	0.02	0.02
Sugar	-0.04	-0.05	-0.17	-0.06	-0.02
Added sugar	-0.11	-0.10	-0.22	-0.10	-0.09
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.00	0.11	0.55	0.15	-0.14

Note: ^a with and without children. ch. = children. ^b BR = before reform, AR = after reform.

Table 4.3b. Results of policy reform (iii), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of added sugar of SEK 0.182

	HOUSEHOLD CATEGORY				
	Couple, 1 child	Couple, 2 children	Couple, ≥ 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.39	0.39	0.32	0.41	0.55
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.47	0.47	0.44	0.50	0.62
Share of bakery goods and ready meals, BR ^b	0.03	0.03	0.02	0.02	0.03
Share of bakery goods and ready meals, AR ^b	0.03	0.03	0.02	0.02	0.03
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	-0.02	-0.02	-0.28	0.01	0.07
Volumes of bakery goods and ready meals	-0.11	-0.11	-0.25	-0.18	-0.12
Fiber	0.09	0.07	0.01	0.12	0.20
Fat	-0.01	0.00	-0.07	0.02	0.11
Saturated fat	-0.06	-0.05	-0.13	-0.03	0.05
Kilojoules	0.04	0.03	-0.02	0.07	0.16
Salt	-0.04	-0.05	-0.10	-0.04	0.04
Sugar	-0.14	-0.13	-0.22	-0.11	0.01
Added sugar	-0.22	-0.22	-0.32	-0.20	-0.05
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.38	0.33	2.13	0.13	-0.32

Note: ^b BR = before reform, AR = after reform.

Table 4.4a. Results of policy reform (iv), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of saturated fat of SEK 0.325

	Average household	HOUSEHOLD CATEGORY			
		Single women	Single women with ch.	Single men ^a	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.52	0.57	0.37	0.52	0.57
Share of bakery goods and ready meals, BR ^b	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR ^b	0.02	0.05	0.03	0.06	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.04	0.06	-0.01	0.03	0.06
Volumes of bakery goods and ready meals	-0.06	-0.07	-0.02	-0.14	-0.03
Fiber	0.11	0.11	0.03	0.06	0.13
Fat	0.01	0.00	-0.06	-0.05	0.03
Saturated fat	-0.03	-0.04	-0.09	-0.08	-0.01
Kilojoules	0.05	0.04	-0.01	0.00	0.07
Salt	0.02	0.02	-0.02	0.00	0.04
Sugar	0.00	0.00	-0.05	-0.02	0.01
Added sugar	-0.01	-0.02	-0.05	-0.02	-0.01
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.00	0.13	0.30	0.36	-0.14

Note: ^a with and without children. ch. = children. ^b BR = before reform, AR = after reform.

Table 4.4b. Results of policy reform (iv), a fiber subsidy of SEK 0.046 funded by an excise duty per gram of saturated fat of SEK 0.325

	HOUSEHOLD CATEGORY				
	Couple, 1 child	Couple, 2 children	Couple, ≥ 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.39	0.39	0.32	0.41	0.55
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.44	0.44	0.26	0.46	0.60
Share of bakery goods and ready meals, BR ^b	0.03	0.03	0.02	0.02	0.03
Share of bakery goods and ready meals, AR ^b	0.02	0.02	0.02	0.02	0.03
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.01	0.01	-0.14	0.04	0.07
Volumes of bakery goods and ready meals	-0.06	-0.08	-0.02	0.02	-0.05
Fiber	0.07	0.04	0.04	0.09	0.15
Fat	-0.04	-0.06	-0.05	-0.01	0.05
Saturated fat	-0.08	-0.10	-0.09	-0.05	0.01
Kilojoules	0.02	0.00	0.01	0.04	0.09
Salt	-0.01	-0.02	-0.03	0.01	0.05
Sugar	-0.04	-0.04	-0.04	-0.02	0.02
Added sugar	-0.06	-0.05	-0.07	-0.04	0.01
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.24	0.36	0.89	0.01	-0.27

Note: ^b BR = before reform, AR = after reform.

Table 4.5. Overall price changes for different household categories as a result of policy reforms

	Average price level, baseline	RELATIVE PRICE CHANGES AS A RESULT OF		
		VAT reform	Subsidizing fiber, taxing added sugar	Subsidizing fiber, taxing saturated fat
Average household	34.87	0.97	1.04	1.02
Single women	38.48	1.01	1.04	1.03
Single women with children	35.30	1.02	1.15	1.05
Single men with/without children	39.27	1.03	1.04	1.05
Couple	34.17	0.95	1.03	1.01
Couple with 1 child	35.42	1.02	1.10	1.04
Couple with 2 children	34.88	1.03	1.09	1.06
Couple with ≥ 3 children	34.19	0.99	1.20	1.05
Three adults	34.76	1.00	1.09	1.04
Seniors	33.81	0.94	1.01	0.99

Note: Excise duty reform (2a)F entails a SEK -0.046 excise duty per gram of fiber, funded by a SEK 0.182 excise duty on added sugar. Excise duty reform (2b) entails a SEK -0.046 excise duty on fiber funded by a SEK 0.325 excise duty on saturated fat.

References

- Amemiya, T. (1974), Multivariate Regression and Simultaneous Equation Models when the Dependent Variables are Truncated Normal, *Econometrica*, 42, 999-1012.
- Banks, J., Blundell, R. and Lewbel, A. (1997), Quadratic Engel Curves and Consumer Demand, *The Review of Economics and Statistics*, 527-539.
- Becker, W and Pearson, M. (2002), Riksmaten 1997-98. Befolkningens kostvanor och näringsintag. Metod- och resultatanalys, Livsmedelsverket, Uppsala.
- Blundell, R. and Meghir, C. (1987), Bivariate Alternative to the Tobit Model, *Journal of Econometrics*, 34, 179-200.
- Blundell, R., Pashardes, P. and Weber, G. (1993), What Do we Learn About Consumer Demand Patterns from Micro Data? *The American Economic Review*, 83, 570-597.
- Brand-Miller, J., Hayne, S., Petocz, P and Colagiuri, S. (2003), Low-glycemic Index Diets in the Management of Diabetes: a Meta-Analysis of Randomized Controlled Trials, *Diabetes Care*, 26: 2261-2267.
- Burton-Freeman, B. (2000), Dietary Fiber and Energy Regulation, *Journal of Nutrition*, 130 (2): 272S-275S
- Chouinard, H.H., Davis, D.E., LaFrance, J.T. and Perloff, J.M. (2007), Fat Taxes: Big Money for Small Change, *Forum for Health Economics & Policy*, 10(2).
- Deaton, A. and Muellbauer, J. (1980), An Almost Ideal Demand System, *The American Economic Review*, 70, 312-326.
- Enghardt Barbieri, H. and Lindvall, C. (2003), Svenska Näringsrekommendationer Översatta till Livsmedel, Livsmedelsverkets rapport nr 1/2003.
- Ferguson, T. (1958), A Method of Generating Best Asymptotically Normal Estimates with Application to the Estimation of Bacterial Densities, *Annals of Mathematical Statistics*, 29, 1046-61.

- Heckman, J. (1979), Sample Selection Bias as a Specification Error, *Econometrica*, 47, 153-161.
- Jacobson, M.F. and Brownell, K.D. (2000), Small Taxes on Soft Drinks and Snack Foods to Promote Health, *American Journal of Public Health*, 90:6, 854-857.
- Kenkel, D.S. and Manning, W. (1999), Economic Evaluation of Nutrition Policy – Or, there’s no such Thing as a Free Lunch, *Food Policy*, 24(2): 145-162.
- Kuchler, F., Abebayehu, T. and Michael Harris, J. (2005), Taxing Snack Foods: Manipulating Diet Quality or Financing Information Programs?, *Review of Agricultural Economics*, 27(1): 4-20.
- Leung, S.F. and Yu, S. (1996), On the Choice Between Sample Selection and Two-Part Models, *Journal of Econometrics*, 72, 197-229.
- Liu S. et al. (1999), Whole-grain Consumption and Risk of Coronary Heart Disease: Results from the Nurses’ Health Study, *American Journal of Clinical Nutrition*, 70(3):412-9.
- Liu S. et al. (2003), Relation Between Changes in Intake of Dietary Fiber and Grain Products and Changes in Weight and Development of Obesity among Middle-Aged Women, *American Journal of Clinical Nutrition*, 78:920-927.
- Mann, J. (2002), Diet and Risk of Coronary Heart Disease and Type 2 Diabetes, *The Lancet*, 360:9335, 783-790.
- Nordström, J. and Thunström, L. (2009a), The Impact of Tax Reforms Designed to Encourage Healthier Grain Consumption, *Journal of Health Economics*, 29, 622-634.
- Nordström, J. and Thunström, L. (2009b) The Impact on Different Household Types of Economic Policies Designed to Increase the Fiber Intake from Grain Consumption, *HUI Working Paper No 22*
- Persson U, Svensson, M. and Ödegaard, K. (2004), Kostnadsutveckling i svensk sjukvård relaterad till övervikt och fetma – några scenarier. Vårdens resursbehov och utmaningar på längre sikt. Stockholm: Landstingsförbundet.

- Persson, U. and Ödegaard, K. (2005), Indirekta Kostnader till Följd av Sjukdomar Relaterade till Övervikt och Fetma, *IHE e-rapport 2005:3*.
- Rasmussen, F., Eriksson, M., Bokedal, C. and Schäfer Elinder, L. (2004), Fysisk Aktivitet, Matvanor, Övervikt och Självkänsla Bland Ungdomar. COMPASS – en studie i sydvästra Storstockholm. Stockholm: Samhällsmedicin, Stockholms läns landsting och Statens Folkhälsoinstitut, R2004:1.
- Schatzkin, A., Mouw, T., Park, Y., Subar, A.F., Kipnis, V., Hollenbeck, A., Leitzmann, M.F. and Thompson, F.E. (2007), Dietary Fiber and Whole-Grain Consumption in Relation to Colorectal Cancer in the NIH-AARP Diet and Health Study, *American Journal of Clinical Nutrition*, 85(5): 1353-60.
- Schulze, M.B., Liu, S., Rimm, E.B., Manson, J.E., Willet, W.C. and Hu, F.B. (2004), Glycemic Index, Glycemic Load, and Dietary Fiber Intake and Incidence of Type 2 Diabetes in Younger and Middle-Aged Women, *American Journal of Clinical Nutrition*, 80(2): 348-356.
- Smed, S., Jensen, J.D., and Denver, S. (2007), Socio-economic characteristics and the effect of taxation as a health policy instrument, *Food Policy*, 32(5-6): 624-639
- Socialstyrelsen. Hälso- och sjukvård. Lägesrapport 2003.
- Svenska Näringsrekommendationer (SNR) 1997. Rekommendationer för Planering av Kost till Olika Grupper. Normer vid Värdering av Näringsintag.” Livsmedelsverket, Uppsala, 1997.
- Tobin, J. (1958), Estimation of Relationships for Limited Dependent Variables, *Econometrica*, 26, 24-36.
- WHO (2004), Food and Health in Europe: A New Basis for Action, *WHO Regional Publications, European Series, No. 96*.
- White, H. (1980), A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity, *Econometrica*, 48, 817-838.
- Willet, W. et al. (2002), Glycemic Index, Glycemic Load, and Risk of Type 2 Diabetes, *American Journal of Clinical Nutrition*, 76:274S-80S.

Appendix

Table a. Results of policy reform (i), zero VAT on Keyhole-labeled bread and breakfast cereals funded by 34.2 percent VAT on bakery goods and ready meals

	Average household	HOUSEHOLD CATEGORY			
		Single women	Single women with ch.	Single men ^a	Couple
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.47	0.52	0.33	0.47	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.50	0.55	0.36	0.51	0.55
Share of bakery goods and ready meals, BR ^b	0.03	0.05	0.03	0.07	0.02
Share of bakery goods and ready meals, AR ^b	0.03	0.05	0.03	0.06	0.02
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.03	0.03	0.01	0.03	0.03
Volumes of bakery goods and ready meals	-0.01	-0.04	0.02	-0.09	0.01
Fiber	0.03	0.03	0.02	0.03	0.03
Fat	0.00	-0.01	-0.02	-0.02	0.00
Saturated fat	-0.01	-0.02	-0.03	-0.03	0.00
Kilojoules	0.01	0.01	0.00	0.00	0.02
Salt	0.01	0.01	-0.01	0.00	0.01
Sugar	0.01	0.01	0.00	0.01	0.02
Added sugar	0.00	-0.01	-0.01	0.00	0.01
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	00.00	0.16	0.22	0.36	-0.08

Note: ^a with and without children. ch. = children. ^b BR = before reform, AR = after reform.

Table b. Results of policy reform (i), zero VAT on Keyhole-labeled bread and breakfast cereals funded by 34.2 percent VAT on bakery goods and ready meals

	HOUSEHOLD CATEGORY				
	Couple, one child	Couple, 2 children	Couple, 3 children	Three adults	Seniors
Share of Keyhole-labeled bread and breakfast cereals, BR ^b	0.39	0.39	0.32	0.45	0.52
Share of Keyhole-labeled bread and breakfast cereals, AR ^b	0.42	0.43	0.21	0.49	0.55
Share of bakery goods and ready meals, BR ^b	0.03	0.03	0.02	0.03	0.03
Share of bakery goods and ready meals, AR ^b	0.02	0.03	0.02	0.02	0.03
Relative change in volumes and intake of nutrients					
Volumes of bread and breakfast cereals	0.02	0.02	0.02	0.02	0.03
Volumes of bakery goods and ready meals	-0.02	-0.01	0.07	0.01	-0.02
Fiber	0.02	0.02	0.02	0.03	0.03
Fat	-0.01	-0.02	-0.01	0.00	0.00
Saturated fat	-0.03	-0.03	-0.02	-0.01	-0.01
Kilojoules	0.00	0.00	0.01	0.01	0.01
Salt	0.00	0.00	0.00	0.01	0.01
Sugar	0.00	0.01	0.00	0.02	0.01
Added sugar	-0.01	-0.01	-0.01	0.01	0.00
Effects on public revenues					
Average relative change in VAT and excise duty paid, in SEK	0.15	0.23	0.05	-0.10	-0.02

Note: ^b BR = before reform, AR = after reform.